THURSDAY, APRIL 28, 1910.

DYNAMICS IN ENGLAND, FRANCE, AND GERMANY.

(1) *Elementary Mechanics of Solids and Fluids.* By Dr. A. Clement Jones and C. H. Blomfield. Pp. vi+366+xvi. (London: Edward Arnold, n.d.) Price 4*s.* 6*d.*

(2) *An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies.* By S. L. Loney. Pp. viii+374. (Cambridge: University Press, 1909–10.)

(3) *Initiation à la Mécanique.* By Ch. Ed. Guillaume. Pp. xiv+214. (Paris: Librairie Hachette and Co., 1909.) Price 2 francs.

(4) *Die Mechanik, eine Einfuhrung mit einem metaphysischen Nachwort.* By Dr. Ludwig Tesar. Pp. xiv+220. (Leipzig and Berlin: B. G. Teubner.) Price 3.20 marks.

(5) *Vorlesungen über technische Mechanik.* By Prof. Dr. August Föppl. III. Festigkeitslehre, 4th edition. Pp. xvi+426. Price 10 marks. VI. Die wichtigsten Lehren der höheren Dynamik. Pp. xii+490. Price 12 marks. (Leipzig: B. G. Teubner, 1909–10.)

NEARLY five years have elapsed since the indefatigable Prof. Perry opened a discussion on the teaching of mechanics at Johannesburg. Mr. Blomfield is a teacher of considerable experience, and this book may be safely assumed to be the outcome of a study of this and other similar reports, combined with a practical knowledge of the difficulties of teaching boys, and of the requirements which a teacher has to satisfy on the part of examining boards over which, unfortunately, he possesses no power of control. There have been a few, but not many, books on elementary mechanics published since the Johannesburg discussion, and we naturally examine the present book with a somewhat hypercritical eye, in the hope of finding some indications as to whether any real improvement has been effected since then. Let us begin with generalities, and then descend to details.

(1) In the first place, a good deal of discussion has taken place as to how far the use of text-books is desirable in school teaching, the following alternatives being proposed:—

(*a*) No text-book.

(*b*) A text-book consisting of examples only.

(*c*) A text-book containing a complete exposition of the subject.

It is the opinion of many of the best teachers that a text-book should contain a brief but sufficiently complete outline of fundamental principles, but that examples should be the main feature. In this respect Messrs. Jones and Blomfield's book leaves nothing to be desired. It is very largely made up of examples, far more than any boy could work through in a reasonable time, and the teacher who wishes to adapt the course to his own requirements will only have to put a tick against those he means to set to his class.

In the second place, it is undoubtedly desirable, as the authors claim, to teach statics and dynamics simultaneously with hydrostatics, and it is important, not only that the three should for convenience be comprised in one book, but also that the simultaneous treatment should not give rise to serious difficulties in regard to logical sequence in any one of the subjects.

When, however, we examine the result we find that the mixture of the three subjects in each chapter leads to some rather striking anomalies, and the reader naturally asks, What has Atwood's machine got to do with the U-tube and the barometer? Why do Boyle's and Charles's law come in the same chapter with graphical methods? What connection exists between centres of gravity and Archimedes's principle, or between force diagrams and centres of pressure? Would not centres of gravity and centres of pressure go better in the same chapter? If, however, the authors seriously think that this somewhat heterogeneous mixture is found beneficial for teaching purposes on the ground that it keeps a variety of different ideas before the pupils at the same time, no doubt something can be said in its favour, and we should gladly defer to their views.

Passing to matters of detail, we naturally expect to find, in the examples, questions of a rather more practical character than in the older text-books. But the pupil who works through the questions might almost believe that there were only three acute angles in existence—30°, 45°, and 60°. Why is it that other angles so seldom figure in them? Every boy nowadays has his tables of logarithms, and the first thing he should do when he learns the parallelogram law and Lami's theorem is to calculate resultants, using the tables of log sines, &c. What is the use of teaching him statics if he can only apply the methods to three particular angles? But the absence of other angles is the more remarkable when we speculate as to the sources from which the questions have been taken, especially in view of the fact that Government examination papers have been consulted, and that in some of these, 30°, 45°, and 60° have, we believe, been taboo for some years past. Again, in the chapter on projectiles, a good many examples are to be solved by writing down the equations, but we have failed to find any attempt to make the pupil *draw the paths of projectiles by plotting.* Is not this calculated to produce the type of student who uses elaborate algebra to prove an almost self-evident result and generally fails? We have had abundant experience of such students' failures in simple projectile questions, and begin to wonder whether it would not be better to omit the subject altogether.

On the other hand, the book contains a good many things which we had believed were at last dead and buried. What is the use of telling a boy that if a particle is going north-east at 10 feet per second for one second "it has travelled a distance OL ($5\sqrt{2}$ feet) due E., and a distance LP ($5\sqrt{2}$ feet) due N."? If he has any common sense he ought to think that it would be equally sensible to say that two people starting from London and Cardiff at 2 p.m., with

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tickets from London to Cardiff and Cardiff to Glasgow, could get to their destinations simultaneously by the 2 p.m. London to Glasgow. It would be far better to omit all these old-fangled misstatements, including the one that "if a particle has simultaneously three velocities represented by the sides of a triangle it remains at rest," and merely to give the definition of component velocities in § 5, and some discussions on relative velocity.

Atwood's machine seems too fashionable to be omitted nowadays, but it would be better to bring friction up to the front before discussing the motion of a 10 lb. weight on a table, pulled opposite ways by weights of 1½ lb. and 2 lb. hanging over the edge, or a 4 lb. mass on an inclined plane. In the figure of the condensing pump the arrow seems to suggest that air enters the barrel when the piston is moving the opposite way. "Whole pressure," which is meaningless except for plane areas, again crops up on p. 217. When shall we see the last of it? The oar once more figures as a lever of the second class. It is to be wished that every person who placed it there would try pulling a boat out in shallow water with the ends of his oars touching the bottom and a boy on the bank holding the boat back with a string. Under "machines" the so-called "first and third systems of pulleys" crop up with their usual pertinacity. It would be interesting if those who take so much interest in these particular machines and ignore the crab were asked to arrange for lifting building materials to the top of a high scaffolding, and to watch the result when their instructions were carried out.

Our general conclusion is that if boys have to learn what is contained in this book they will be efficiently and well trained on these lines by following Messrs. Jones and Blomfield; but there are a good many things they had far better leave unlearned, and a good many other things they ought to learn instead. It should be mentioned that calculus is not used, and moments of inertia are not included in the scope of the book.

(2) Controversial questions regarding the teaching of mechanics do not enter so prominently in connection with Prof. Loney's book, for by the time its standard has been reached dynamics has practically become a branch of pure mathematics, while, on the other hand, the student has had a good laboratory course in physics or engineering. The book, in fact, pretty exactly fits the requirements of B.Sc. candidates in a modern university college in the third year of their curriculum. It deals with rectilinear motion (including resisting media), central orbits, motion about a fixed axis, uniplanar rigid dynamics, energy and momentum, a little three-dimensional rigid, Lagrange's equations, &c. There is always a difficulty with these students, because this ground assumes a knowledge of pure mathematics that they cannot acquire before their third year. The appendix on differential equations is useful in this connection. A few points will have to be attended to in a future edition. The equation of motion for varying mass (p. 130) does not generally hold when a body is *parting with* matter. D'Alembert's principle requires more explanation than is contained in the statement, "Now the internal forces of the body are in equilibrium among themselves, for by Newton's third law there is to every action an equal and opposite reaction." This explanation the lecturer can, however, give. But a most amazing and doubtless unintentional mistake is made on p. 302, where the equations of motion in three dimensions are given as $Ad^2w_x/dt^2 = L$ instead of Euler's equations. We should like to have seen a few more examples in which the answer leads to a definite conclusion in the form of a numerical result instead of so many algebraic formulæ connecting masses m, lengths $2a$, and angles θ. But such questions are, we admit, rather hard to collect, and the teacher and student should, therefore, be grateful for the flywheel questions on pp. 217–9.

Up till the present no one book has sufficed for students taking this course, and, indeed, there has been great difficulty in advising them as to what to get. Prof. Loney has done useful work in providing students with a suitable work, and when he states that he has verified every question, the task cannot have been an easy or profitable one.

In this revision, the paradoxical rough board on a smooth plane seems to have escaped notice in p. 210, ex. 2, while on p. 217 we have "A uniform rod AB is freely movable on a rough inclined plane whose inclination to the horizon is i and whose coefficient of friction is μ about a smooth pin fixed through the end A." "Coefficient of friction of a rough plane about a smooth pin" reminds us of the newspaper English so often quoted in *Punch*.

The treatment of centrodes is very useful.

(3) M. Guillaume's "Initiation" is stated to be one of a series intended to be used for teaching children. In this connection, the question arises, What is the age of the children contemplated by the author? In the editorial preface by M. C. A. Laisant four to twelve years is suggested. But, even after allowing for the differences between English and French children, the author's treatment of the subject seems too philosophical for such young pupils. As a preliminary preparation to the study of mechanics we have a chapter on "How Nature is Studied," the headings of the paragraphs being "Observation and Experiment," "Approximation and Simplification," "Need of Simplicity," "The Limits of Experiment," "Illusion," "Education of the Senses; Measurement," "Induction and Deduction." Illustrations are taken from the photographs of moving bullets, photometry, and so forth. In the next chapter, which deals with kinematics, we have a discussion of space, velocity, and acceleration graphs. The author in the preface considers that dynamics should be treated before statics. His argument might, however, very well be used the other way. He asks why the majority of bodies on the earth appear to be at rest, and points out that this is due to the existence of resistances such as friction, and remarks *inter alia* that if these forces are unknown at the time when statics is begun

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this becomes an artificial science or a simple abstraction. Would it not, however, be equally correct to describe dynamics as an "artificial science or simple abstraction" because it deals only with what *would* happen if certain existing resistances were absent?

The subject-matter extends up to and including couples, circular motion, a little about properties of matter, such as elasticity and ballistics, and a final paragraph dealing with Jules Verne's hypothetical voyage to the moon.

It is not to be denied that "philosophy of science" is much more studied in France than in this country. It also appears that the book is primarily written for those who have to teach children rather than for the children themselves. All we can say is that a course of instruction based on this book would in all probability be far above the heads of English children of the ages contemplated.

(4) While Prof. Tesar has "said his own say" in his preface and metaphysical appendix, his object in the rest of the book has been to present the principles of mechanics in a clear and intelligent form, and to employ practical illustrations as far as possible. In both these aims he appears to have been very successful. He is careful to distinguish between forces (Kräfte) and force effects (Kraftäuszerungen), pointing out that the parallelogram law applies to the latter, and that its truth for any physical vector quantities is based on experience. His readers should learn to discriminate clearly between the formal rational dynamics and its applications to the practical study of mechanics. For want of this distinction the whole subject in less careful hands often becomes more appropriately describable as dogmatics. The practical illustrations are very instructive and suggestive. How many who have taught rigid dynamics have thought of working out the condition whether a bell will or will not ring when it is swung? The author gives practical calculations for a bell in Cologne Cathedral cast from the cannon captured in the Franco-Prussian War, which failed to ring until its clapper was altered in length.

(5) As has been previously pointed out in reviews, Prof. Föppl's treatises on technical mechanics are of a far more advanced character than the mechanics taught commonly to technical students in this country. Vol. iii., which includes a large portion of the mathematical theory of elasticity, now reaches us in its fourth edition. The new volume, "The Most Important Studies of Higher Dynamics," deals with relative motion, systems with several degrees of freedom, in particular compound pendulums, including the bell and its clapper, the gyrostat, and an outline of hydrodynamics. Under the gyrostat we have a detailed discussion of Schlick's ship governor, and in a circular issued with the book we are asked to point out that the Brennan mono-rail came too late to be included in the book, a short note at the end being all that was possible, as the whole of the text was already in print. It is, however, pointed out that the theory of the Schlick gyroscope is applicable with slight modifications to the mono-rail, some terms occurring in the equations having merely to be reversed in sign. Thus an interesting exercise is provided for those possessing the necessary mathematical knowledge, to go over the work introducing the necessary changes, and doubtless the next edition will see them in the text.

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HARDY TREES AND SHRUBS.

Trees and Shrubs of the British Isles, Native and Acclimatised. By C. S. Cooper and W. P. Westell. Vol. i., pp. xxxii+lxxxiv+108; vol. ii., pp. viii+261; 78 full-page plates by C. F. Newall. (London: J. M. Dent and Co., 1909.) Price, two vols., 21*s*. net.

AMID the torrent of books on gardening with which a patient public has been deluged during recent years, we have searched in vain for a really comprehensive and authoritative work on hardy trees and shrubs. Of mere book-making there has, of course, been no end. It is so easy to sit at a desk and boil down from Loudon, Sargent, &c., and from the copious literature in horticultural journals, sufficient to make a respectable-looking volume, without ever taking the trouble to turn over a leaf or dissect a flower on one's own account. But this method has its disadvantages. The same stale old errors are once again repeated, and to them our new author must, perforce, add some of his own. There has been too much of this kind of tree literature in the past, and it was with a feeling of pleasant anticipation that we turned to these two handsome volumes in the hope that a work had at last been written worthy of the subject.

That it marks a considerable advance on much that has appeared is certain, but its scope is somewhat limited, and the authors do not appear to us to have done the best that could have been done within the limits they set themselves. British trees and shrubs are done thoroughly and well, and those portions dealing with them constitute the most valuable part of these volumes. When the authors deal with what they term "acclimatised," as distinct from native, species, their work often suggests the study and the bookshelf, rather than the open air and the living tree. For it is by no means free from error, and at times shows a lack of intimate knowledge of the plants dealt with.

The book opens with an introduction in which the general subject is discussed pleasantly and suggestively. It is an attempt to interest the hitherto uninterested reader, not only in the more evident beauties of leaf and flower, but to get him also to appreciate those profounder beauties of trunk and branch and bud which we are afraid the average reader often does not discern, but which make the leafless woods in their season as full of delight to the real tree-lover as the full leafage of June. This part of the work was well worth doing and is well done.

Some fifty or sixty pages are then devoted to the discussion of injurious and useful insects, galls, and fungoid pests, with directions for the composition and application of various remedies. This, although useful, is too liberal an allowance for such subjects in a

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